CLAIMS

What is claimed is:

1. An ice machine, comprising:

a makeup water conduit comprising one or more ultraviolet transmission surfaces and one or more ozone injection ports;

a circulating water conduit comprising one or more ultraviolet transmission surfaces and one or more ozone injection ports, wherein water is circulated by a circulating pump from a water reservoir to evaporator plates;

one or more ultraviolet radiation sources, wherein the one or more ultraviolet radiation sources are adjacent to the ultraviolet transmission surfaces;

an ozone generator in fluid communication with the one or more ozone injection ports; and

one or more controllers, wherein the controllers start and stop the one or more ultraviolet radiation sources, the ozone generator, or combinations thereof.

2. The ice machine of claim 1, wherein the ozone injection ports are at locations upstream of each of the one or more ultraviolet radiation sources, downstream of each of the ultraviolet radiation sources, or combinations thereof.

3. The ice machine of claim 2, wherein the ozone injection ports are located less than one conduit diameter downstream of the one or more ultraviolet radiation sources.

4. The ice machine of claim 2, wherein the ozone injection ports are located less than three conduit diameters downstream of the one or more ultraviolet radiation sources.

5. The ice machine of claim 1, wherein the ultraviolet radiation source is an ultraviolet lamp, and wherein a majority of the ultraviolet radiation produced by the ultraviolet lamp is about 254 nanometers.

6. The ice machine of claim 1, further comprising:

a refill valve, wherein the refill valve is located in the makeup water conduit, and wherein the refill valve opens to refill the water reservoir whenever a water level in the water reservoir reaches a low level setpoint.

7. The ice machine of claim 6, wherein one of the one or more ozone injection points is located no more than three conduit diameters downstream of the refill valve.

8. The ice machine of claim 6, wherein one of the one or more ozone injection points is located no more than one conduit diameter downstream of the refill valve.

9. The ice machine of claim 1, wherein one of the one or more ozone injection points is located no more than three conduit diameters downstream of the circulating pump discharge.

10. The ice machine of claim 1, wherein one of the one or more ozone injection points is located no more than one conduit diameters downstream of the circulating pump discharge.

11. The apparatus of claim 1, wherein the ozone generator comprises an electrolyzer.

12. The apparatus of claim 11, wherein the ozone leaves the ozone generator in a form of gaseous ozone, ozonated water, or combinations thereof.

13. The apparatus of claim 12, wherein the ozone generator produces gaseous ozone, the ozone generator further comprises:

at least one hydroscopic membrane, wherein the gaseous ozone may pass through the membrane and water cannot pass through the membrane.

14. The apparatus of claim 11, wherein the electrolyzer comprises:

a cathode electrode;

an anode electrode;

an electrolyte disposed between the cathode and the anode, wherein the electrolyte is a proton exchange membrane; and

means for retracting the anode electrode away from the proton exchange membrane to stop ozone production.

15. The apparatus of claim 14, wherein the means for retracting are a bourdon tube, a set of bellows, or a hydraulic piston.

16. The apparatus of claim 15, wherein a motive fluid to move the means for retracting is a refrigerant from a refrigerant compressor discharge line or pressurized water from the circulating pump discharge or a potable water supply.

17. The apparatus of claim 14, wherein the means for retracting is an electric motor.

18. The apparatus of claim 1, wherein the ozone generator is in fluid communication with each of the ozone injection ports.

19. The apparatus of claim 1, wherein one of the one or more controllers for starting and stopping ozone generation communicate electrical signals, mechanical signals, or combinations thereof with devices selected from a refrigeration compressor, a condenser fan, or the circulating pump.

20. A method for decontaminating water in an ice making machine, comprising:

exposing water in a region of a makeup water conduit to ultraviolet radiation exposing water in a region of a circulating water conduit to ultraviolet radiation through the one ore more ultraviolet transmission surfaces;

injecting ozone into the water adjacent the downstream ends of the ultraviolet radiation exposing region; and

controlling ozone production with a controller, wherein an ozone generator is not continuously producing ozone.

21. The method of claim 20, further comprising:

injecting ozone into the water reservoir.

22. The method of claim 20, wherein the ozone injection ports are less than 10 conduit diameters downstream of the ultraviolet transmission surfaces.

23. The method of claim 20, wherein the ozone injection ports are no more than 1 conduit diameter downstream of the ultraviolet transmission surfaces.

24. The method of claim 20, wherein the ultraviolet radiation is generated by an ultraviolet lamp.

25. The method of claim 20, wherein the makeup water conduit further comprises a makeup valve, and wherein an ozone injection port is located downstream of the makeup valve, the method further comprises:

injecting ozone into the ozone injection port downstream of the makeup valve.

26. The method of claim 25, wherein the ozone injection port downstream of the makeup valve is less than 10 conduit diameters downstream of the makeup water valve.

27. The method of claim 25, wherein the ozone injection port downstream of the makeup valve is less than 1 conduit diameter downstream of the makeup water valve.

28. The method of claim 20, further comprising:

producing ozone for injection into the ozone injection ports.

29. The method of claim 28, wherein the ozone generator is an electrolyzer.

30. The method of claim 29, wherein the ozone leaving the electrolyzer is in a form selected from gaseous ozone and ozonated water.

31. The method of claim 29, further comprising:

separating gaseous ozone from the ozonated water in an anode of the electrolyzer.

32. The method of claim 31, wherein the step of separating gaseous ozone is accomplished with at least one hydrophobic membrane.

33. The method of claim 29, wherein step of controlling ozone production with a controller further comprises:

pulling an anode electrode from a proton exchange membrane to stop ozone production;

pushing the anode electrode against the proton exchange membrane to start ozone production.

34. The method of claim 33, wherein the step of controlling ozone production further comprises:

receiving a communication signal from the controller to push an anode electrode against a proton exchange membrane, wherein the communication from the controller is an electrical signal, a mechanical signal or combinations thereof.

35. The method of claim 33, wherein the controller is an electrical device, a mechanical device, or combinations thereof.

36. The method of claim 33, wherein the controller is a bourdon tube, a set of bellows, or a hydraulic piston.

37. The method of claim 33, wherein the motive fluid to move the controller is a refrigerant from a compressor discharge line or pressurized water from the circulating pump discharge or a potable water supply.

38. The method of claim 20, wherein the ozone generator is in fluid communication with each of the one or more ozone injection ports.